

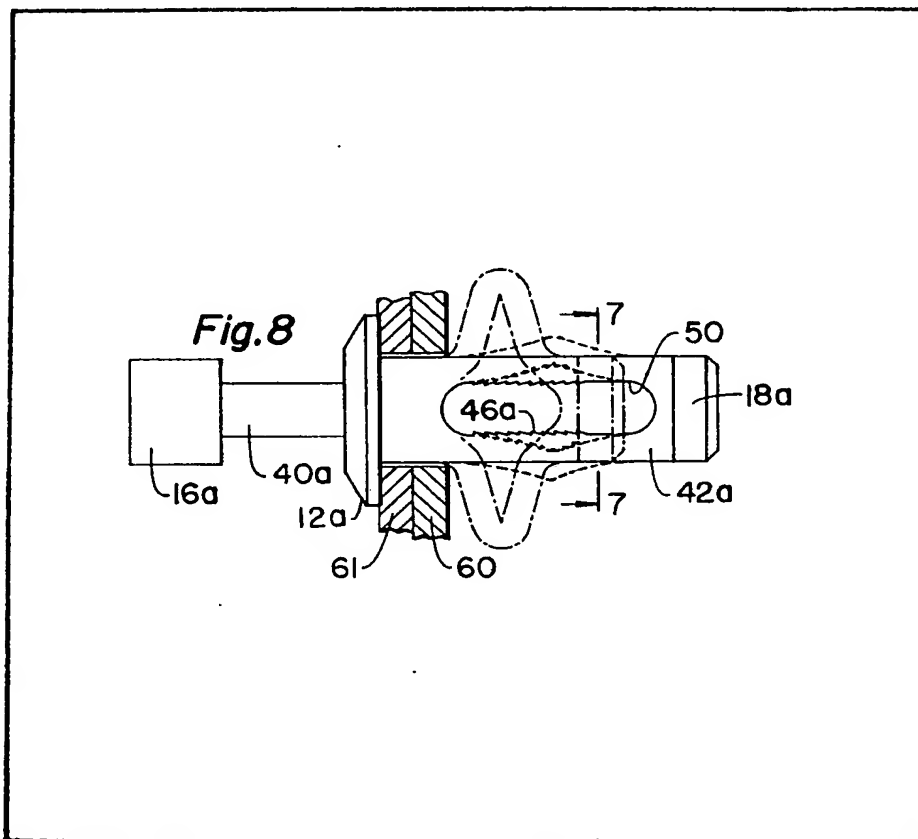
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(54) Plastics Blind Rivets

(57) A plastics blind rivet includes a tubular female member 42a having a flange-like head 12a and slots 50, and a male member 40a having a shank insert-moulded within the hollow space of said female member 42a so as to create complementary shapes between said members. The male member 40a extends through the head 12a and includes an enlarged portion 18a contacting the end of the

female member 42a. The shank includes longitudinal flat surfaces carrying locking teeth 46a co-operating with locking teeth on similar flat surfaces on the interior of the female member, so that withdrawal of the male member 40a out of the female member 42a reduces the length of the female member 42a with consequent bowing of the tubular wall of the female member 42a by bending along straight lines transverse to the longitudinal axis of the rivet.



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Fig.1 PRIOR ART

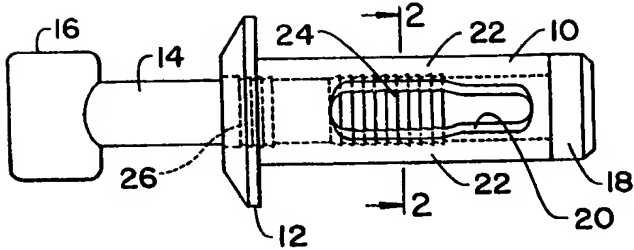


Fig.2 PRIOR ART

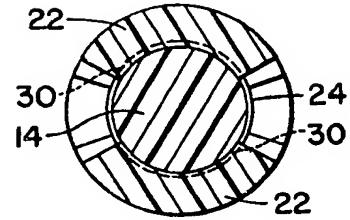


Fig.3
PRIOR ART

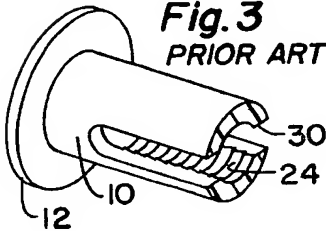


Fig.4

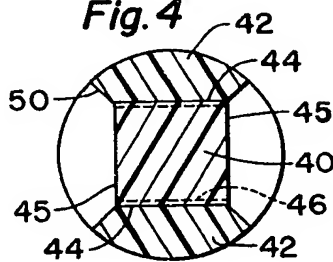


Fig.5

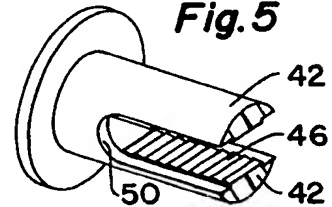


Fig.6

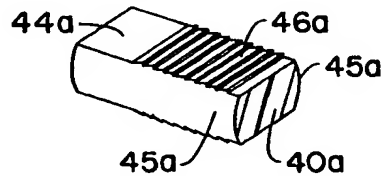


Fig.7

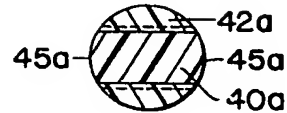


Fig.8

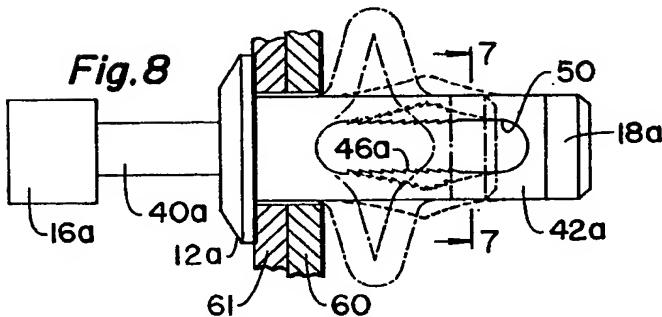


Fig.9

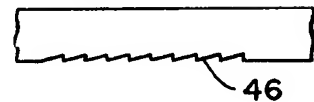


Fig.10

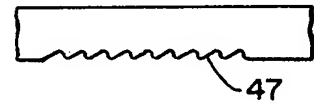


Fig.11

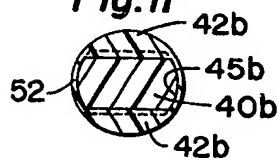


Fig.12

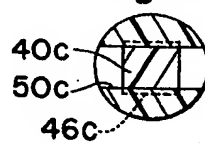


Fig.13

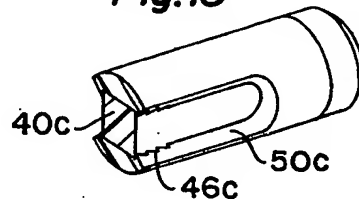
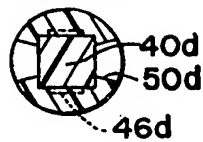
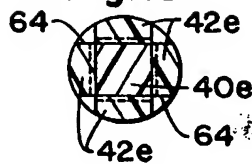
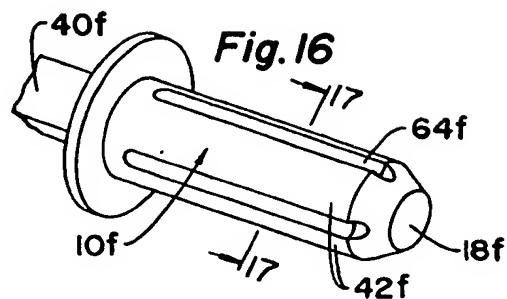
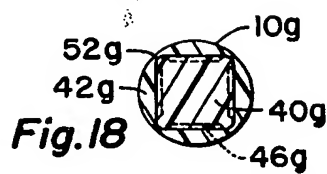
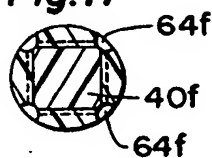
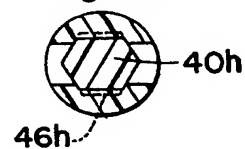
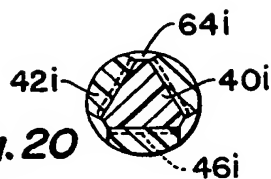
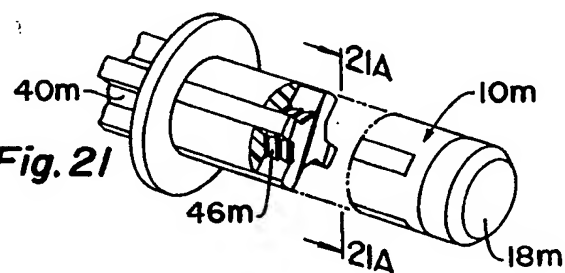
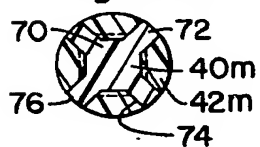
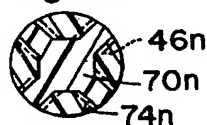
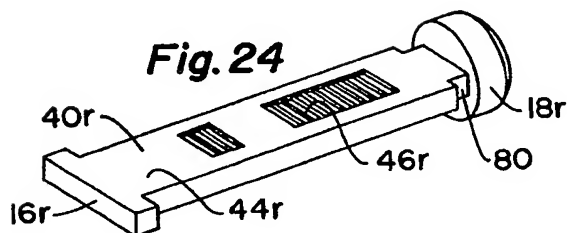
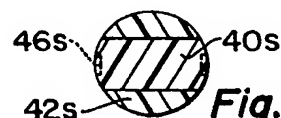
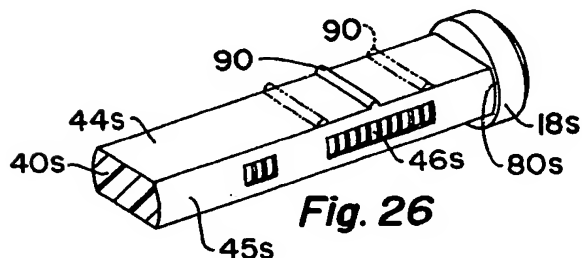
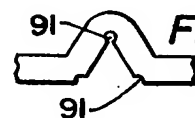


Fig. 14**Fig. 15****Fig. 16****Fig. 17****Fig. 19****Fig. 20****Fig. 21****Fig. 21A****Fig. 22****Fig. 23****Fig. 25****Fig. 24****Fig. 27****Fig. 26****Fig. 28**

SPECIFICATION

Improv d Plastics Pull-up Rivets

This invention relates to one-piece plastics blind rivets. Blind rivets in the prior art normally comprise a sleeve used as the female member having a head at one end, and a male member or pin which at the leading end thereof has a diameter greater than the inside diameter of the sleeve. As disclosed by United States Patents 3,178,989 and 3,230,818, for example, the male and female members of such blind rivets are separately fabricated, the female member being of a malleable metal such as an aluminium alloy or mild steel, and are assembled by having the pin inserted into the sleeve. When such devices are inserted into a workpiece, and the pin is withdrawn through the head, the sleeve is expanded and pressed against the workpiece, causing the rivet to be tightened.

Metallic blind rivets of this type are complicated to fabricate, and require the secondary operation of assembling the male and female members. When the pin is drawn out to provide the required tightening, the excess portion of the drawn pin must be cut off. Several approaches have been used, including the provision of a groove in the pin so that when the pin is withdrawn from the sleeve and a predetermined tensile force is exerted on the pin the pin will automatically separate. With such a rivet, however, there is a possibility that the pin will break off before the rivet has provided perfect tightening to the workpiece. Additionally, such pins are retained in position solely by frictional forces caused by the tight tolerances.

Blind rivets of plastics materials, however, have found virtually no acceptance, since such rivets normally fail to perform as designed, and sustain breakage. Moreover, owing to the memory factor of the plastics material as well as the elasticity of such material, it is difficult to retain such rivets in the desired configuration when the pin is withdrawn. Additionally, there is the possibility of the pin being drawn back into the sleeve after the step of tightening when the sleeve returns to an initial position due to this memory factor.

A plastics rivet which overcomes many of these deficiencies has been disclosed in an application for United States Patent Serial No. 660,379 filed February 23, 1976, which application is assigned to an associated company of the present applicants. That application provides a blind rivet of plastics material which provides a virtually infallible tightening, and eliminates the possibility of the male member being released from the female member after the step of tightening. This prior art uses a round mandrel-like pin or male member which has a plurality of axially spaced annular rings which are moulded on the male member. Such a male member is then insert-moulded into a female sleeve to form complementary shoulder means in the shank portion as well as in the head area. As the pin is withdrawn, such a shoulder means

interengage in the area of said head and lock the pin in withdrawn position. It has been noted, however, that, when using a cylindrical pin, the complementary side wall of the sleeve or female member also forms a segment of a circle, when viewed in cross section. As the pin is drawn up to expand the sleeve, there is the necessity of bending this arched beam-like member into the expanded petal-like array. This can set up stress situations which could result in a tearing or fracturing of the sleeve as it is pulled up, dependent upon the type of material used in fabricating the sleeve.

An object of the present invention is to provide rivets of plastics material which provide positive tightening relative to the workpiece, eliminate the possibility of the male member being released from the female member after the step of tightening, and additionally overcome the deficiencies of the prior art by eliminating the stress concentrations found in such prior art.

Another object of the present invention is to provide a blind rivet of plastics material which is easily mounted on a riveting tool and permits a continued or sequential riveting operation.

A blind rivet according to the present invention is of one or more plastics materials and includes a tubular female member having (when considered in an upright attitude) a flange-like head on the outer periphery at the upper open end thereof, a male member having a shank insert-moulded in and forming the hollow space of said female member so as to create intimate complementary shapes between said members, said female member having a plurality of elongated relieved areas in the tubular wall thereof disposed in a longitudinal axial direction, said male member extending through said head and further including at the lower end of said shank a portion of increased size in contact with the lower end of said female member opposite said head, said male member and female member each possessed of locking means for preventing the male member from being retrogressively moved after being withdrawn relatively to the female member, said shank including a plurality of substantially flat, longitudinally disposed surfaces, which form flat wall sections on the interior of the female member between said relieved areas whereby an operation of withdrawing said male member from said female member and consequently causes the tubular wall thereof between said relieved areas to expand in the shape of petals with said expanded wall cooperating with said head to fasten a workpiece held therebetween, said expanded tubular wall bending along substantially straight lines transversely located on said flat wall sections.

The blind rivets of the present invention are preferably manufactured by a two step moulding process where either the male member or the female member is first moulded to its given shape and subsequently is placed in position in a secondary die and the respective female member or male member is moulded. The rivet thus

produced, therefore, has a totally complementary male member incorporated in the female member. The manufacture is easy to perform and can be readily accomplished on a mass production scale. Since it is unnecessary to pull the male member through the female member during assembly, as is the case in the manufacture of metallic elements, the head portion of the shank can be readily moulded to a shape capable of easy engagement with a tool used for pulling the male member, as well as to interconnect a multiplicity of shank heads so that a plurality of rivets can be inserted in an appropriate tool and subjected to a sequential continuous riveting operation, as compared with conventional metallic blind rivets which inevitably have to be secured one by one in the chuck of the tool used for driving.

The accompanying drawings show various rivets embodying the present invention, by way of example, and also a prior art rivet.

Figure 1 is a side elevational view of the prior art rivet;

Figure 2 is a sectional view taken along line 2—2 of Figure 1;

Figure 3 is a perspective view in partial section of a female member of the prior art without the male member in position;

Figure 4 is a sectional view of a first embodiment of the present invention;

Figure 5 is a perspective view in partial section of a female member, without the male member in position, of the type shown in Figure 4;

Figure 6 is a fragmentary sectional perspective view of a male member of a second embodiment of the present invention;

Figure 7 is a sectional view taken along line 7—7 of Figure 8;

Figure 8 is an elevational view showing a rivet as shown in Figures 6 and 7 in the assembled relationship to a panel, and also showing in phantom the expansion of the rivet during withdrawal of the male member;

Figure 9 shows one form of cammed tooth means capable of being utilized on the male and female portions of rivets embodying the present invention;

Figure 10 shows a modified form of cammed shoulder or tooth means to be used for locking the male member relative to the female member;

Figure 11 shows a variation on the embodiment shown in Figure 7, wherein web means are provided externally of the side surfaces of the male member;

Figure 12 is a sectional view of a further embodiment of the present invention;

Figure 13 is a sectional fragmentary view of the lower end of a rivet as in Figure 12;

Figure 14 is a sectional view of a variation on the embodiment shown in Figures 12 and 13;

Figure 15 is a sectional view of still another variation;

Figure 16 is a perspective view in partial fragmentation showing a further rivet embodying the present invention, having axial relief grooves

to provide a plurality of four wall sections, said grooves being a variation on the means of relief, as opposed to the ports as shown in the prior art and in Figure 8;

Figure 17 is a sectional view taken along line 17—17 of Figure 16;

Figures 18, 19, 20 show other configurations which may be utilized in the present invention;

Figure 21 is a cut-away perspective view in fragmented form of a further embodiment of the present invention using a cruciform shape of male member;

Figure 21A is a sectional view taken along line 21—21 of Figure 21;

Figures 22 and 23 show variations in the disposition of the locking means on the cruciform male member as opposed to the variety shown in Figures 21 and 21A;

Figure 24 is a perspective view of a male member in a further embodiment of the present invention, having flat surfaces and in this instance recessed locking means disposed below the plane of the flat faces;

Figure 25 is a sectional view of the member shown in Figure 24 when positioned within the female member;

Figure 26 shows a variation on the male member shown in Figure 24, with the locking means being recessed below the side surfaces, and additionally having rib means projecting from the major dimension of the male member to form complementary relief means in the female member to provide positive location of the bend lines;

Figure 27 is a sectional view showing the male member of Figure 26 in position within a female member; and

Figure 28 is a fragmentary sectional view of one wall portion of a female member which has been expanded into the petal-like configuration upon withdrawal of the male member shown in Figure 26, and showing the relief means formed by the transverse ribs on the major surface of such male member.

In the Figures, rivets are shown on their sides, with heads to the left, whereas the terminology used in the following description considers the rivets with their heads uppermost.

Referring now to the drawing wherein similar numerals are utilized to designate similar parts, and letter suffixes are utilized to designate the various embodiments of the present invention, Figures 1 through 3 disclose the prior art referred to hereinabove. The prior art provides a female member 10 having a tubular shape and provided on the outer periphery of the upper open end with a flange-like head 12. A male member has a rod-like shank 14 insert-moulded within the hollow space of the female member 10. This shank is provided at the upper end and extending beyond the head 12 with a pulling head 16, and at the lower end protruding from the lower open end of the female member 10 with an enlarged portion 18 that contacts the lower end of the female member 10. The female member 10 has a thin

5 wall section in its principal tubular area to enjoy flexibility and is provided with two elongated ports 20 which extend in the longitudinal direction. In the prior art embodiment shown there are two such ports disposed opposite of each other along the axis of the female member. These ports run substantially the whole length of the principal tubular wall of the female member with the exceptions of the upper and lower extremities of said wall which are continuous annular rings. This provides a pair of wall portions 22 which, upon withdrawal of the shank 14, in a direction to the left as viewed in Figure 1, results in the enlarged portion 18 causing the tubular female member 10 to contract axially and the wall portions 22 to be bent outwards in petal-like array.

20 The portion of the shank 14 which is insert-moulded in the hollow space of the female member 10 includes locking means constituted by a plurality of annular cammed shoulders 24 with the abrupt shoulder facing in the direction of the enlarged nose portion 18. A second set of annular rings 26 are disposed adjacent to the flange head 12 to thereby provide stepped surfaces at that extremity of the female member when it is formed about the male member. Thus, when the shank 14 is pulled out of the head by means of the enlarged portion 16, the annular rings 24 will move axially within the female portion until they engage the shoulder means located within the head. This prevents the shank 14 from moving in a retrograde direction after withdrawal.

35 As can be best seen in Figures 2 and 3, the cylindrical shank 14 forms a curvilinear surface on the interior of the female member that forms wall portions 22 as segments of a circle. When the male member 14 is moved by withdrawal through the head 12, it will be appreciated that the variations in diameter between the inner and outer surfaces of the wall portions 22 will set up stress points 30 when the wall portions 22 attempt to flatten out during their expansion into the petal-like configuration.

50 The primary object of the present invention is to overcome the possibility of this stress relationship and to do so the male member is provided with a plurality of substantially flat surfaces carrying the locking means. Referring now to Figure 4 where there is shown an embodiment of the present invention, the male member 40 cooperates with a pair of oppositely disposed wall portions 42 and has a pair of oppositely facing generally flat surfaces 44 carrying locking means, such as cammed shoulders 46 shown in phantom, in engagement with mutual locking surfaces on the wall portions 42 as best seen in Figure 5. In this exemplary embodiment the wall portions 42 are separated on opposite sides by elongated ports 50 with the ports 50 providing access for suitable means in the secondary moulding die to engage the side walls 45 of the mandrel 40 to ensure proper

65 location during the secondary moulding operation.

Referring now to Figures 6 to 8, this embodiment utilizes a male member 40a, which is shown in Figure 6 in fragmentary partial section, and is generally oblong in cross-section. It includes a pair of flat oppositely facing surfaces 44a which carry the cammed shoulder locking means 46a. The flat surfaces 44a are interconnected by curvilinear side surfaces 45a, with the side surfaces 45a falling on a diameter substantially equal to the external diameter of the rivet. Thus the member 40a will have its side surfaces, through a substantial portion of its flank, closing off on the interior wall of the secondary mould utilized to form the female portions 42a. Figure 8 shows an entire rivet of the type contemplated by use of the mandrel in Figure 6 as inserted through a workpiece 60 and 61 and showing the petalling action as the member 40a is withdrawn to the left (as seen in Figure 8) through the head.

It will be appreciated by those skilled in the art that, while a very sharp shoulder or tooth form 46, as shown in Figure 9 on a female portion, is the ideal configuration for the interior wall of the female member and the exterior of the male member, it may be necessary to use an alternative tooth form 47, as seen in Figure 10, that has a more rounded characteristic. This rounded characteristic or shape will fill out better with the plastics material in the mould and eliminate stress-riser problems in the moulding operation.

Figure 11 is a variation on the form shown in Figure 7, in that the male member 40b has its curvilinear surfaces 45b falling on a diameter less than the external diameter of the rivet and thereby forming a thin web 52 which interconnects the wall portions 42b. Such a web can be designed either to fracture or to stretch, dependent upon the types of material utilized in fabrication of the female member.

It will be appreciated that many variations can be designed, to accommodate the various uses to which the rivets are to be utilized as well as to provide various modes of manufacture. For example, Figure 12 illustrates the use of a substantially square male member 40c with substantially parallel-sided ports 50c. In this embodiment the locking cammed shoulders 46b extend the full width on opposite faces of mandrel 40c. The lower portion, shown in fragmentary perspective, of a rivet using this mandrel can be seen in Figure 13; however, in Figure 13 the sides of the ports 50d have a slight angle for a better draft angle in the mould. Figure 14 shows a variant where angled ports 50d are utilized, but in this embodiment the locking means 46d only extend across a partial width of the mandrel 40d.

Referring now to Figures 15 to 18, it has been previously indicated that it is possible to have the locking shoulder means on a plurality of the flat surfaces of the male member. In these three embodiments the locking teeth are on all four flat surfaces of the square male member. In Figure 15

the square member 40e is positioned within a female member having four wall portions 42e that are separated from one another by four generally V-shaped grooves 64 that would extend for a substantial portion of the length of the exterior of the female member.

Figure 16 shows a variant in which the grooves are semi-circular in cross-section, as best seen in Figure 17. It will be appreciated that the groove 64f does not have to extend or communicate all of the way between the exterior surface of the female portion 10f and the corners of the member 40f. Rather, the grooves can stop short of contacting the member 40f, if desired, to provide a web-like portion which will interconnect the individual wall portions 42f that will petal out when the male member 40f is withdrawn. Further, it will be noted that the enlarged nose portion 18f may also be grooved for ease in manufacture and extraction from the die.

Figure 18 shows a male member 40g that is so proportioned that its corners lie closely adjacent the exterior surface of the female member 10g to provide web-like portions 52g. This latter effect is best accomplished by limiting the width of the locking means 46g so that they do not extend all the way across the flats of the member 40g.

Figure 19 shows a hexagon-shaped mandrel 40h having the locking means or cammed shoulders 46h disposed on opposite flat surfaces thereof. The hexagon-shape will give a slightly stronger configuration due to its greater mass than some of the other configurations shown.

Figure 20 shows a further embodiment where the male member 40i is generally triangular in cross-section. This provides three wall portions 42i for petalling into locking arrangement, with the locking means 46i being carried on each of the flat faces of the triangular member 40i. It will be noted that in this instance the female member is relieved axially through a substantial portion of its length by three grooves 64i. From the teachings shown in the prior embodiments it will be appreciated that the groove 64i can be of full depth, even with the apices of the triangles 40i truncated or, alternatively, they may be of shallower depth to provide a web-like interconnection between the wall portions 42i.

Referring now to Figures 21, 21A, 22 and 23, these next embodiments utilize a male member 40m which is generally cruciform in configuration. It includes a central generally square core 70 and a plurality of fins 72 which are elongated axially extending ribs emanating from the corners of the central core 70. As can be seen in the cutaway perspective view shown in Figure 21, and identified in Figure 21A, the fins 72 include sidewalls 74 and free edges 76. The free edges 76 in the shown embodiment fall on a diameter substantially equal to the external diameter of the female member 10m, and the male member 40m can be inserted into a cylindrical bore of a die with the free end 76 acting to shut-off the plastic material in the secondary moulding operation. In this fashion the

individual wall portions 42m, which in this embodiment are four in number, are separated from one another by the fins 72 except for a small axial length adjacent the lower end against which the enlarged mandrel portion 18m rests. In the embodiment shown in Figures 21 and 21A the locking cam shoulders are disposed on the flats of the central core 70. In the embodiment shown in Figure 22 the side walls 74n are used to carry the locking cam shoulders 46n. The last embodiment in this configuration, seen in Figure 23, utilizes the free edges 76p to carry the locking cam shoulder means 46p. In all of these embodiments a similar complementary shoulder means is provided in the area of the head for engagement with the locking means as the mandrel is withdrawn through the head.

The last two embodiments of this invention, as shown in Figures 24 to 28, utilize a substantial rectangular male mandrel, 40r and 40s respectively, with the embodiment shown in Figure 24 having the locking means 46r recessed below the flat surface 44r. In order to maintain a juncture between the wall sections that will be formed in the female member adjacent the lower nose portion 18r, a recess 80 is provided in the mandrel to provide such connection. In the embodiment shown in Figure 26 the locking means 46s carried by the mandrel 40s are positioned on the narrow side edge 45s and, as in the previous embodiment, are recessed below the surface of the side surfaces 45s. To provide a juncture between adjacent wall portions for the petalling action, the head portion 18s is relieved as at 80s to provide the necessary juncture, which in this embodiment will assume the form of a thin web somewhat similar to that shown in Figure 11, as previously described. This embodiment includes an additional feature in that at least one transverse rib 90 is positioned on each flat surface 44s. These ribs 90 create a relief 91 in the female side wall portion and thereby promote and provide a positive bend line during the petalling action; this can be most clearly seen in the fragmentary sectional view shown in Figure 28.

One method for manufacture of a blind rivet of the present invention is to provide metal dies shaped to conform to the outer contour of the male member, with molten plastics material injection moulded to produce a male member. The male member then is placed within a die shaped to conform to the overall contour of the rivet, including the female portion thereof, and further molten plastics material is introduced to fill up this cavity. By this double moulding technique, a blind rivet having a male member and a female member integrally assembled with the male member forming the interior hollow portion of the female member in close tolerance relationship can be accomplished.

Conversely of the method just described, the rivet may be manufactured by first moulding a female member by injecting molten plastics material into metal dies shaped to conform to the female member, and subsequently placing the

created female member into dies shaped to the overall contour of the rivet whereupon the male member is then formed. By either of the methods described blind rivets having the male member

5 incorporated in the female member with complementary juxtaposed surfaces can easily be produced by the double moulding technique.

The plastics material used in the present invention may be freely selected from among the thermo-plastic synthetic resins known in the art. Examples include nylon, polycarbonate, polypropylene, polyacetal and polyethylene. The plastics material is suitably selected to meet the particular purpose for which the produced rivets

15 are utilized.

The male member and the female member in a rivet may be produced from the same kind of plastics material or they may be made from different kinds of plastics materials. When two different kinds of plastics materials are utilized, the melting point of the plastics material to be used in the first moulding operation should be higher than that of the other plastics material to be used in the secondary moulding operation. If such a choice is not made, the male member may possibly be fused onto the female member in the moulded rivet. Where the same kind of plastics material is used, or two different kinds of plastics material having a common melting point are used, possible fusion of the male and female members may be prevented by first coating the moulded male member with a known mould release agent, such as, for example, silicone, before it is placed in the mould for the female member and the molten plastics material is introduced. The moulding processes described above are carried out by following known techniques for injection moulding using a plastics material. Since the rivet of the present invention is manufactured by the double moulding method as described above, the two members of the rivet may be manufactured by using plastics materials different in colour as well as in quality or characteristics. By appropriate shaping of the protruding portion of the shank as well as the head of the female member, a rivet of the present invention may be used as a decorative article from a colour stand-point, or as a means to retain a secondary element such as a table clip, a moulding clip or any other desired fastening means which can be made common with the head portion of the female member so long as the male member can be extracted and withdrawn through the head of the female member. It will be readily appreciated that the rivets can be utilized for differing workpiece thicknesses due to their ability to bend at different lengths along the petalling section.

Thus, the present invention as described above provides a rivet of plastics material that can be easily mass produced, by eliminating the work of assembling the male member with the female member. The device also eliminates the possibility of the male and female members coming apart after the rivets have been inserted and also while the rivets are being transported or

stored prior to installation. When the rivet is fastened to the workpiece, the male member will not come out of or be disassociated from the female member unless the entire rivet is destroyed. Therefore inexpensive mass produced plastics materials can be utilized for a safe, stress-free, blind rivet when manufactured in accordance with the teachings of the present invention.

Claims

75 1. A blind rivet of one or more plastics materials, including a tubular female member having (when considered in an upright attitude) a flange-like head on the outer periphery at the upper open end thereof, a male member having a shank insert-moulded in and forming the hollow space of said female member so as to create intimate complementary shapes between said members, said female member having a plurality of elongated relieved areas in the tubular wall thereof disposed in a longitudinal axial direction, said male member extending through said head and further including at the lower end of said shank a portion of increased size in contact with the lower end of said female member opposite said head, said male member and female member each possessed of locking means for preventing the male member from being retrogressively moved after being withdrawn relatively to the female member, said shank including a plurality of substantially flat, longitudinally disposed surfaces, which form flat wall sections on the interior of the female member between said relieved areas, whereby an operation of withdrawing said male member from said female member through said head decreases the length of said female member and consequently causes the tubular wall thereof between said relieved areas to expand in the shape of petals with said expanded wall cooperating with said head to fasten a workpiece held therebetween, said expanded tubular wall bending along substantially straight lines transversely located on said flat wall sections.

2. A rivet according to claim 1, wherein said means for preventing the retrogressive movement of the withdrawn male member includes a plurality of cammed shoulder means axially spaced on said male member and at least one complementary shoulder means in the region of said head on the interior of said female member, whereby at least one of said cammed shoulders means, upon withdrawal of said male member, comes into tight engagement with said at least one complementary shoulder means and prevents return of said male member to its initial position.

3. A rivet according to claim 2, wherein said shank includes two oppositely facing flat surfaces which carry said cammed shoulder means.

4. A rivet according to claim 3, wherein said shank is generally oblong in cross-section, and further includes two curved surfaces interconnecting at opposite ends thereof the said two flat surfaces.

5. A rivet according to claim 4, wherein said curved surfaces lie on a diameter substantially

equal to the diametral measurements of said female tubular member, and serve to relieve said tubular member to form two bendable wall portions to expand to the shape of petals when said male member is withdrawn.

6. A rivet according to claim 4, wherein said curved surfaces lie on a diameter less than the diametral measurement of said female tubular member, a thin web formed on the tubular portion of said female member overlying in intimate contact said surfaces and initially interconnecting said tubular wall portions which expand to the shape of petals when said male member is withdrawn.

7. A rivet according to claim 3, wherein said shank is substantially square in cross-sections.

8. A rivet according to claim 7, wherein said tubular female member includes a pair of longitudinally disposed ports along a substantial portion thereof which communicate with the two flat sides of said shank that interconnect said two oppositely facing flat surfaces carrying said cammed shoulders.

9. A rivet according to claim 8, wherein said ports are radially tapered.

10. A rivet according to claim 7, wherein said shank carries cammed shoulders on all four substantially flat surfaces.

11. A rivet according to claim 10, wherein the exterior of said female tubular member is relieved by axial groove means, with one of said grooves being disposed adjacent each corner of said shank to thereby form four axially extending wall portions which expand to said petal shape when said male member is withdrawn through said head.

12. A rivet according to claim 11, wherein said groove means form ports which communicate between the corners of the shank and the exterior of said female tubular member.

13. A rivet according to claim 11, wherein said groove means are depressions in said tubular female member which form web-like axially disposed thin portions which overlie the corners

of said shank and initially interconnect the wall portions which expand to said petal shape.

14. A rivet according to claim 2, wherein said shank is substantially triangular in cross-section, with all three substantially flat surfaces of said shank carrying a plurality of said cammed shoulder means.

15. A rivet according to claim 14, wherein said tubular female member is relieved on the exterior thereof by axially disposed groove means positioned adjacent the axially extending apices of said triangular shank.

16. A rivet according to claim 2, wherein said shank is generally cruciform in cross-section.

17. A rivet according to claim 16, wherein said shank includes a substantially square central core, and substantially rectangular axially disposed fins which extend radially from each corner of said central core.

18. A rivet according to claim 17, wherein at least said central core carries said cammed shoulder means.

19. A rivet according to claim 17, wherein at least the flat side walls of said fins carry said cammed shoulder means.

20. A rivet according to claim 17, wherein at least the radial extremities of said fins carry said cammed shoulder means.

21. A rivet according to claim 3, wherein said shank is generally rectangular in cross-section, the two broad flat faces of said shank including a plurality of cammed shoulder means which are recessed below each of said flat faces.

22. A rivet according to claim 3, wherein said shank is generally rectangular in cross-section and the two narrow side edges of said shank include a plurality of cammed shoulder means.

23. A rivet according to claim 1, substantially as described with reference to Figures 4 and 5, Figures 6 to 8, Figure 11, Figures 12 and 13, Figure 14, Figure 15, Figures 16 and 17, Figure 18, Figure 19, Figure 20, Figures 21 and 21A, Figure 22, Figure 23, Figures 24 and 25, or Figures 26 to 28 of the accompanying drawings.

